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PATENT SPECIFICATION

NO DRAWINGS

974,571

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Date of filing Complete Specification: May 24, 1963.

Application Date: June 5, 1962. No. 21656/62.

Complete Specification Published: Nov. 4, 1964.

Index at acceptance:—C7 A(8A1, 8A3, 8D, 8Z3, 8Z12, 17); G6 C8D

International Classification:—C 22 c (G 21)

COMPLETE SPECIFICATION

Improvements in or relating to Magnesium Base Alloys

We, MAGNESIUM ELEKTRON LIMITED, a British Company, of Lumm's Lane, Clifton Junction, Swinton, Manchester, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The object of this invention is to provide magnesium base alloys having improved resistance to grain growth when used at elevated temperatures.

One use of magnesium base alloys involving prolonged exposure at elevated temperatures is as fuel cans in nuclear reactors. In one type of reactor magnesium cans are used to surround uranium fuel and to protect it from oxidation. It is an essential requirement of the magnesium alloy used for this purpose that it remains sufficiently ductile that the changes in dimensions occurring in the uranium during irradiation do not result in fracture of the magnesuim can.

An alloy which is used commercially for this purpose is described in British Patent Specification No. 776,649 and contains 0.25 to 1.1 per cent aluminium and 0.002 to 0.1 per cent beryllium the remainder being magnesium. The alloy sometimes contains a trace of silicon as an unintentional impurity e.g. 0.005 per cent.

This alloy however suffers from the disadvantage that during exposure to the highest temperatures, which may be up to 500°C, the grain size increases and thereby ductility of the alloy is reduced. Such reduction of ductility would make it unsafe to subsequently expose the fuel element at lower temperatures (e.g. 200°C) although such subsequent exposure may be desirable to achieve most economic use of the uranium fuel.

We have now found that by adding at least 0.01% silicon to this type of alloy the tendency for grain growth to occur on exposure to elevated temperatures is considerably reduced as shown by the following examples.

Known alloy containing nominally 0.8% aluminium, 0.01% beryllium and an unintentional impurity of 0.005% silicon

Condition	Grain Size
As extruded	0.1 mm
Heated 30 min @ 400° C.	0.12 mm
Heated 16 hrs @ 400° C.	0.3 mm
Heated 5 hrs @ 515° C.	0.37 mm
Heated 16 hrs @ 515° C.	0.45 mm

Alloy in accordance with present invention containing nominally 0.8% aluminium, 0.01% beryllium together with a silicon content as shown

Condition	Grain Size		
	Si content 0.05%	Si content 0.10%	Si content 0.23%
As extruded	0.10 mm	0.09 mm	0.09 mm
Heated 30 min @ 400° C.	0.10 mm	0.09 mm	0.09 mm
Heated 16 hrs @ 400° C.	0.11 mm	0.09 mm	0.10 mm
Heated 30 min @ 515° C.	0.13 mm	0.10 mm	0.10 mm
Heated 16 hrs @ 515° C.	0.19 mm	0.12 mm	0.11 mm

In the specification of our co-pending Application No. 14183/62 (Serial No. 963,073) it is shown that the addition of 0.05 to 0.25% of manganese to this type of alloy improves the resistance to grain growth at elevated temperatures. Use of manganese, however, has the disadvantage of impairing neutron economy in nuclear reactors owing to the high neutron capture cross section of manganese. Silicon has a considerably lower neutron cross section capture than manganese and hence its use would not involve as great a loss of neutron efficiency.

For the purpose of the present invention the proportion of silicon should be at least 0.01%, preferably at least 0.05%, and up to 1%. If excessive amounts of silicon are added to this alloy it would be feared that its ductility would become undesirably low. The alloys contain from 0.01 up to 1.0 per cent silicon; however for best creep ductility the silicon content should not exceed 0.3% and preferably should be not more than 0.25%.

The joint use of silicon together with manganese as described in said prior specification may also be advantageous.

The percentages referred to above are percentages by weight.

The aluminium content of the alloy is 0.25 to 1.5% preferably 0.5 to 1.5 per cent.

One or more of the following additional ingredients may be included:

Beryllium from nil to 0.1 per cent, e.g. from 0.002 to 0.1 per cent preferably up to 0.02 per cent
Calcium from nil to 0.4 per cent
Zinc from nil to 3.0 per cent

The manganese may be from nil to 0.25 per cent preferably not more than 0.1 per cent.

WHAT WE CLAIM IS:—

1. A magnesium base alloy consisting apart from impurities of:—

Silicon	from 0.01 to 1.0	per cent by	weight
Aluminium	from 0.25 to 1.5	„ „ „	„
Manganese	from 0 to 0.25	„ „ „	„
Beryllium	from 0 to 0.1	„ „ „	„
Calcium	from 0 to 0.4	„ „ „	„
Zinc	from 0 to 3.0	„ „ „	„
Magnesium	Balance		

2. A magnesium base alloy consisting apart from impurities of:—

Silicon	from 0.05 to 0.25	per cent by	weight
Aluminium	from 0.5 to 1.5	„ „ „	„
Magnesium	Balance		

3. A magnesium base alloy as claimed in claim 2 containing also 0.002 to 0.02 per cent beryllium.

4. A magnesium base alloy as claimed in claim 2 or 3 containing also calcium up to 0.4 per cent and/or zinc up to 3.0 per cent.

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Leamington Spa: Printed for Her Majesty's Stationery Office, by the Courier Press (Leamington) Ltd.—1964. Published by The Patent Office, 25 Southampton Buildings, London, W.C.2, from which copies may be obtained.